

THREE NEW SPECIES OF *AMPHINEMURA* (PLECOPTERA: NEMOURIDAE) FROM EASTERN NORTH AMERICA¹

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ABSTRACT: Descriptions of three new species of *Amphinemura* (Plecoptera: Nemouridae) from eastern and southern United States are presented. Illustrations of male and female genitalia are provided. Distributional records are given for each species.

During a study of the Nemouridae fauna of eastern North America, three previously undescribed species of *Amphinemura* were discovered. One species is only known from Alabama and a second species is recorded from a limited geographical region of Texas and Louisiana. However, the third species is distributed along the Appalachian Mountains from Pennsylvania south to Georgia. This paper presents the descriptions of these species and compares them with similar *Amphinemura* species found in eastern North America.

Amphinemura alabama, NEW SPECIES

(Figs. 1-3)

Male. Macropterous. Length of forewings 6.0-6.5 mm; length of body 5.0-5.5 mm. Body and wings brown, wing veins slightly darker in color; venation typical for genus. Two cervical gill remnants present on each side of midline, both with multiple branches near apex. Cerci small, membranous and one segmented. Hypoproct widest in basal 2/3, broadly rounded, apical 1/3 much narrower, with round tip; vesicle present, long, narrow and rounded at apex (Fig. 1). Paraprocts with three lobes: inner lobes long, thin, lightly sclerotized and nearly covered by apex of hypoproct; middle lobes, large, well developed and generally darkly sclerotized, tip rounded, naked and white, remainder of apical portion, beyond curve, bearing many dark, well developed spines on inner margin, basal portion large and expanded laterally below cercus; outer lobes, long, thin and bearing a fringe of short spines on sclerotized ridge, extending from rounded apex to completion of curve, base slightly expanded toward cercus (Figs. 1, 2). Epiproct broad at base in dorsal aspect, narrowing gradually to small, rounded apex, base of dorsal sclerite darkly sclerotized, apex exhibiting very darkly sclerotized area at the bilobed tip; lateral aspect with a narrow curved base, expanding gradually toward apex, with widest portion slightly anterior to midlength, apex shaped into a rounded upturned tip, lateral sclerite long and very thin, extending from base to apex, ventral sclerite shaped like narrow keel, which dips downward near widest portion in profile, bearing several small spines; basal sclerites large and triangle-shaped. Anterior margin of ninth tergum forming U-shaped band below apex of epiproct (Fig. 2).

Female. Macropterous. Length of forewings 7.0-7.5 mm; length of body 6.0-6.5 mm. Body, appendages and wings similar to male. Subgenital plate exhibiting large, median notch, bordered by sclerotized, truncate plates on posterior margin, with smaller notch lateral to large plates, and smaller sclerotized sclerite near lateral margins. Pregenital plate large, sclerotized and broadly rounded, extending over anterior margin of eighth sternum (Fig. 3).

Diagnosis. *Amphinemura alabama* males can be separated from males of the closely related *A.*

¹ Received June 15, 1996. Accepted July 8, 1996.

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delosa (Ricker) (1952) by the shape of the paraprocts and the location of the spines. In *A. alabama* both the middle and outer lobes are long and thin and end in small rounded tips, which are naked of spines. The curved portion of both the middle and outer lobes are covered with numerous, dark, backward directed spines. However, in *A. delosa* the outer lobe is thin and without spines except for a small, narrow patch near the apex. The middle lobe bears many dark spines but only on the inner surface, at the bend. In addition, the apex is more bulbous and bears 6-10, large, laterally directed spines. The epiproct in *A. alabama* exhibits a long, upward curved tip laterally, while in *A. delosa* it is small and even with the dorsal margin. The anterior margin of the tenth tergum curves downward into a U-shape in *A. alabama* but it is straight in *A. delosa*. The female subgenital plates are quite similar but the small lateral lobes are smaller in *A. alabama* and do not reach the posterior margin of the eighth sternum.

Material. Holotype male, allotype female and 5 male and 2 female paratypes, Alabama, Limestone County, Cairo Branch, Elk River, 5-IV-1982, B.J. Armitage. Holotype and allotype deposited at the United States National Museum, Smithsonian Institution, Washington, D.C. Additional paratypes were studied from the following places: ALABAMA: same locality data as holotype, 24-IV-1982, 2 females; 27-IV-1982, 4 males and 3 females; 4-V-1982, 4 males and 6 females; 7-V-1982, 1 male and 2 females; 16-V-1983, 1 male and 3 females; Limestone Co., spring in Sugar Creek Estate, 2-V-1983, B.J. Armitage 1 male; 4-VI-1983, 1 male and 2 females.

Etymology. The specific name is a noun in apposition after the state where the type specimens were collected.

Discussion. *Amphinemura alabama* is only known from a small geographical area in north central Alabama. This interesting new species was brought to my attention by Boris Kondratieff after it was sent to him by the collector, Brian Armitage, then at Athens College. Examination of extensive collections from the surrounding states: Georgia, Mississippi and Tennessee has failed to produce additional records. Hopefully collecting efforts in the future will add to our knowledge of this species.

Amphinemura appalachia, NEW SPECIES

(Figs. 4-6)

Male. Macropterous. Length of forewings 7.5-8.5 mm; length of body 5.0-6.0 mm. Body and wings light brown, wing veins darker in color; venation typical for genus. Two cervical gill remnants present on each side of midline, both with multiple branches near apex. Cerci, small, membranous and one segmented. Hypoproct widest in basal 3/4, broadly rounded, apical 1/4 forming short, narrow point; vesicle present, long and narrow with rounded apex (Fig. 4). Paraprocts with three darkly sclerotized lobes: inner lobes large and L-shaped, inner portion with sharp point reaching to base of epiproct, lateral arm extending to base of cercus; middle lobe long and extremely thin, broadest at base, extending upward in a smooth C-shaped arc, which ends in a sharp point, apical area bearing 1-3 tiny spines, membranous area below basal sclerites bearing a few, stout, darkly sclerotized spines; outer lobe short and thin, beginning at cercus, encircling base of cercus from the ventral to dorsal side, around outer margin (Fig. 4). Epiproct broadest at apex in dorsal aspect, dorsal sclerite mostly darkly sclerotized, darkest coloration on lateral-apical margins, with tiny tube visible medially at bifurcate tip; ventral sclerite generally flat, no spines present but with textured pattern of dots throughout most of length; lateral aspect narrow at base and apex, slightly thickened beyond midlength; basal sclerites stout and somewhat triangle-shaped (Fig. 5).

Female. Macropterous. Length of forewings 8.5-9.5 mm; length of body 6.0-7.0 mm. Body appendages and wings similar in color to male. Subgenital plate with two large ear-like lobes separated medially by a V-shaped notch, lobes darkly sclerotized, especially in mature specimens, which also exhibit dark, rough area below notch, lobes extending well over base of ninth sternum (Fig. 6).

Diagnosis. *Amphinemura appalachia* males can be separated from the very closely related *A. wui* (Claassen) (1936) by the shape of the median lobe of the paraprocts and by the details of the epiproct. The median paraproctal lobe is extremely thin and delicately curved in a C-shape in *A.*

appalachia, while in *A. wui* it is thicker and quite angular where it bends, forming more of a block-like letter. The basic shape of the epiproct in these species is similar. However, the apex is thinner in *A. wui* and the dorsal sclerite is larger and more darkly sclerotized in *A. appalachia*. The lobes on the subgenital plate of the female of *A. appalachia* are more angular apically than in *A. wui*. In addition, the notch is more rounded in *A. wui* while in *A. appalachia* it is shallower and V-shaped.

Material. Holotype male, allotype female and one male paratype, South Carolina, Pickens County; Wildcat Creek, 20-III-1968, P.H. Carlson. Holotype and allotype deposited at the United States National Museum, Smithsonian Institution, Washington, D.C. Additional paratypes were examined from the following places: GEORGIA: Dawson Co., Amicalola Creek, Hwy 53, west of Dawsonville, 4-III-1991, R.W. Baumann and S.M. Clark, 2 males and 3 females. Lumpkin Co., tributary of Frogtown Creek, Hwy 19, near Desoto Falls, 4-III-1991, R.W. Baumann and S.M. Clark, 1 female. NORTH CAROLINA: Jackson Co., Willetts, 23-III-1940, T.H. Frison, C.O. Mohr and A.W. Hawkins, 2 males and 2 females. Macon Co., Upper Ball Creek, Coweta Hydrologic Laboratory, 7-22-IV-1984, A.D. Huryn, 2 males and 4 females; 20-IV-20-V-1984, 12 males and 13 females. PENNSYLVANIA: Carbon Co., Mud Run, Hickory Run State Park, 3-V-1996, E.C. Masteller, 1 female. Monroe Co., small stream below Camelback Ski Area, Pocono Mountains, 3-V-1991, R.W. Baumann and S.A. Wells, 2 males and 2 females. SOUTH CAROLINA: Same locality data as holotype: 4-III-1967, 1 male and 3 females; 20-III-1968, 3 males and 7 females; 9-IV-1968, 1 male and 6 females; 12-IV-1968, 11 females. TENNESSEE: Carter Co., tributary of Stony Creek, Hwy 91, Winner, 6-III-1991, R.W. Baumann and S.M. Clark, 3 males. VIRGINIA: Grayson Co., Lewis Fork, Rt. 603, 10-IV-1980, B.C. Kondratieff, 3 males and 3 females; 19-IV-1980, 1 male and 1 female. Madison Co., Big Meadows, Shenandoah National Park, 20-IV-1938, H.H. Ross and B.D. Burks, 2 males; Hog Camp Brook, tributary Rose River, Shenandoah National Park, 6-V-1987, S.Hiner, 3 males. Page Co., Lewis Spring, trail to Lewis Falls, Big Meadows, Shenandoah National Park, 3-VI-1983, B.C. Kondratieff, 5 males and 5 females. Patrick Co., Patrick Springs, Hwy 680, 3 miles north of Patrick Springs, 11-III-1991, R.W. Baumann and R.F. Kirchner, 1 female.

Etymology. This species is known from Pennsylvania to Georgia in the Appalachian Mountains. Thus the name *A. appalachia* was chosen to emphasize the fact that it is only found in this major mountain range.

Discussion. *Amphinemura wui* was originally described as *Nemoura sinuata* by Wu (1923). However, since the name *sinuata* was previously used for a European species, Claassen renamed the species after the describer. During the intervening years some stonefly workers noticed that *A. wui* seemed to be variable but until now the actual details were not clarified so that the two species could be separated consistently.

Even though *A. appalachia* is widely distributed in eastern North America, it is much less frequently collected than *A. wui*. This is because it emerges earlier in the year and prefers more pristine, spring-fed streams that usually occur at higher elevations. Additional collecting in the northern Appalachians, earlier in the year, will possibly add to its known range of distribution.

Amphinemura texana, NEW SPECIES

(Figs. 7-9)

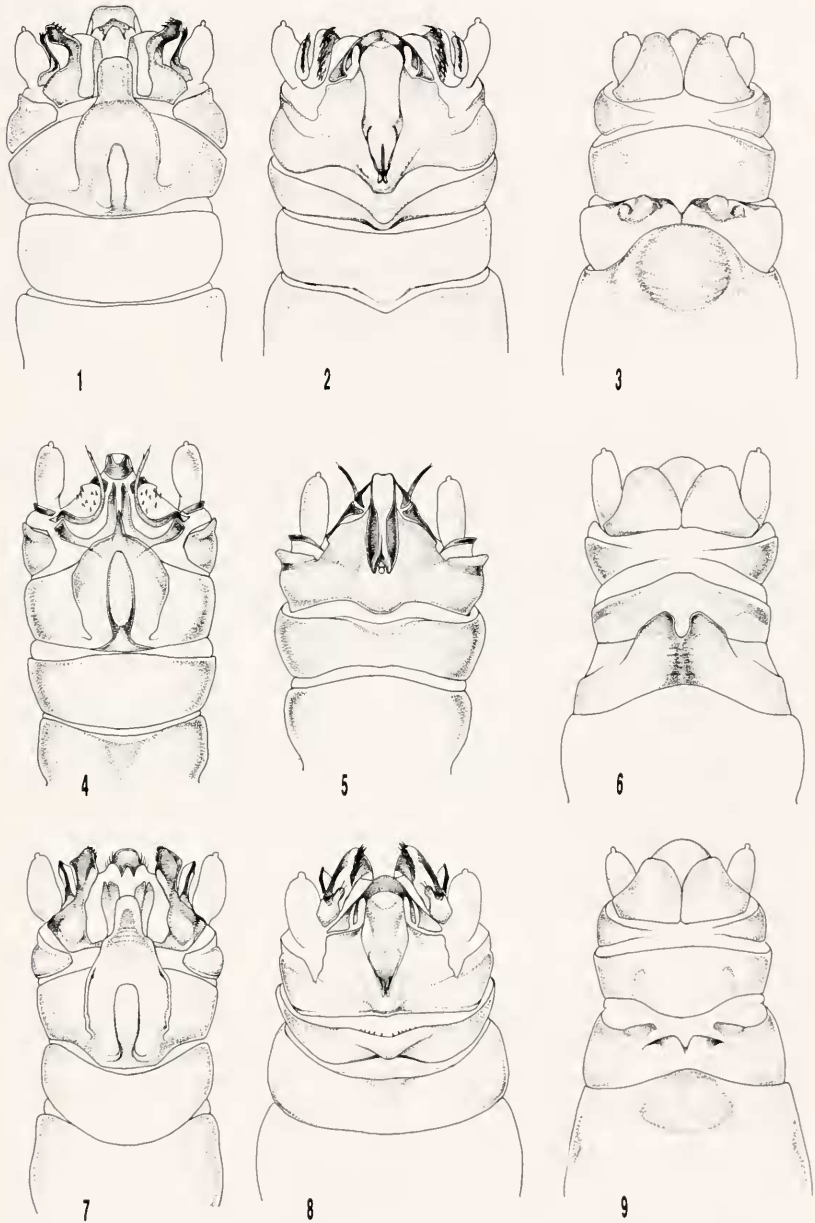
Male. Macropterous. Length of forewings 6.5-7.0 mm; length of body 5.5-6.0 mm. General color brown, legs and abdomen yellow-brown, wings fumose, with darker areas along veins, venation typical for genus. Two cervical gill remnants present on each side of midline, both with mul-

multiple branches near apex. Cerci small, membranous and one segmented. Hypoproct widest in basal 2/3, broadly rounded, apical 1/3 narrower, with rounded tip; vesicle present, long and thin, with rounded apex (Fig. 7). Paraprocts with three lobes: inner lobes short, somewhat elongate, with bilobed apex, partially covered by hypoproct; middle lobes large, well developed and darkly sclerotized, base broad, narrowing before greatly expanded area at curve, which exhibits patch of inward directed spines, apex membranous ventrally but modified into distinctive, sclerotized, handle-like process dorsally, that points inward toward base of epiproct, bearing one to three spines at the tip; outer process, short, narrow and without spines, slightly wider at base, pointed apex not reaching forward beyond dorsal margin of cercus (Figs. 7, 8). Epiproct broadest at base in dorsal aspect, narrowing toward pointed, bilobed tip, producing wedge-shaped outline, dorsal sclerite darkly sclerotized at base but remainder of sclerite only lightly sclerotized; lateral aspect with lateral arms thin and reaching to apex, which forms slightly upturned apical process, when compared to generally wide epiproct, ventral sclerite extending downward slightly, producing rounded keel behind apex, which bears rows of large, thin spines; basal sclerites, short, stout and somewhat triangle-shaped. Median, posterior margin of ninth tergum bearing row of short spines (Fig. 8).

Female. Macropterous. Length of forewings 7.5-8.0 mm; length of body 7.0-8.0 mm. Body, appendages and wings similar to male. Subgenital plate with large, median notch, bordered by elongate, gently rounded lateral lobes, which are sclerotized along outer margin, also with additional sclerotized patch on each side along lateral-posterior margin of eighth sternum, especially visible in mature specimens. Pregenital plate well developed, lightly sclerotized and extending over anterior-median area of eighth sternum in gently rounded arc (Fig. 9).

Diagnosis. *Amphinemura texana* is most similar to *A. nigritta* (Provancher) (1876). Males can be most easily separated by the shape of the paraprocts. The middle lobe of the paraprocts in *A. texana* ends in rounded apex which bears a large prong-like, oblique process. This process is heavily sclerotized and has 1-3 terminal spines. The rest of the membranous apex is naked or exhibits 1-2 very small, ventral spines, that are actually an extension of the large patch of spines beginning at the median bend. In *A. nigritta* the middle lobe terminates in a lightly colored membranous lobe, which is essentially bulbous. The inner margin contains a patch of 3-5 tightly pressed spines and the outer margin has 3-4 more loosely scattered, dark spines (see Hitchcock 1974, Figs. 115 and 116). Females cannot be separated consistently from females of *A. nigritta* without associated males.

Material. Holotype male, allotype female and 2 male and 31 female paratypes, Texas, Houston County, Wood Spring Branch, Elm Creek, Hwy 7, 1 mile west of Kinnard, 21-IV-1990. R. W. Baumann and C.R. Nelson. Holotype and allotype deposited at the United States National Museum, Smithsonian Institution, Washington, D.C. Additional paratypes were studied from the following places: LOUISIANA: Grant Parish, Cypress Creek, Catahoula District, Kisatchie National Forest, Rd. 17, 2.5 miles west of Dry Prong, 8-IV-1984, R.E. DeWalt, 1 male (reared); 19-IV-1984, 1 female (reared); 29-IV-1994, 1 male. TEXAS: Anderson Co., Saddler Creek, Hwy 287, south of Palestine, 30-III-1974, S.W. Szczytko and K.W. Stewart, 1 male. Cass Co., Frazier Creek, Hwy 8, east of Red Hill, 14-IV-1973, S.W. Szczytko and K.W. Stewart, 3 males and 8 females; creek, Hwy 8, 5.8 miles north of Linden, 14-IV-1973, S.W. Szczytko and K.W. Stewart, 8 males and 8 females. Cherokee Co., creek, Hwy 21, 1-1/2 miles east of Alto, 14-III 1973, S.W. Szczytko, 3 males; 30-III-1974, S.W. Szczytko and K.W. Stewart, 4 males and 4 females. Harrison Co., creek, 12 miles east of Marshall, 26-III-1970, R. Greer, 1 male; creek, Hwy 59, 6 miles north of Marshall, 14-IV-1973, S.W. Szczytko and K.W. Stewart, 2 males and 1 female. Houston Co., Whiteley Creek, Hwy 227, 3 miles northwest of Ratcliff, Davey Crockett National Forest, 21-IV-1990, R.W. Baumann and C.R. Nelson, 1 male and 2 females. Nagadoches Co., Naconiche Creek, Hwy 593, southwest of Appleby, 30-III-1974, S.W. Szczytko and K.W. Stewart, 5 females. Muse Spring, tributary of Amaladeros Creek, Chireno, 22-IV-1990, R.W. Baumann and C.R. Nelson, 2 females. Sabine Co., creek, Hwy 87, 2.9 miles south of junction Hwy 21, 12-III-1973, S.W. Szczytko, 1 male; Moss Creek, 2 miles north of Milam, Red Hills Lake Campground, Sabine National Forest, 22-IV-1989, R.E. DeWalt, 11 males and 19 females; 23-IV-1990, R.W. Baumann and C.R. Nelson, 5 males and 22 females; Boregas Creek, Hwy 21, 1 mile west of Milam, 23-IV-1990, R.W. Baumann and C.R. Nelson, 1 female. Shelby Co., headwaters of Grannies Creek near Boles Field, Sabine National



Figs. 1-3. *Amphinemura alabama*. 1. Male genitalia, ventral view. 2. Male genitalia, dorsal view. 3. Female genitalia, ventral view. Figs. 4-6. *Amphinemura appalachia*. 4. Male genitalia, ventral view. 5. Male genitalia, dorsal view. 6. Female genitalia, ventral view. Figs. 7-9. *Amphinemura texana*. 7. Male genitalia, ventral view. 8. Male genitalia, dorsal view. 9. Female genitalia, ventral view.

Forest, 23-IV-1990, R.W. Baumann and C.R. Nelson, 2 females. Tyler Co., creek, Hwy 287, north of Chester, 30-III-1974, S.W. Szczytko and K.W. Stewart, 2 males.

Etymology. The name *A. texana* was chosen since the species was first recognized from Texas and it occurs widely along the eastern portion of the state.

Discussion. In Ricker (1952) he notes that what he recognizes as *A. nigritta* is a variable species. In fact, he illustrates three different forms of the two outer paraproctal lobes. His figure 10 is somewhat similar to *A. texana* but the range of variation observed in his Illinois specimen still falls within that of *A. nigritta*.

Amphinemura texana seems to be restricted to the Piney Woods of east Texas and the adjacent area in the Kisatchie National Forest of Louisiana. The habitat where the species occurs is in small headwater springs or creeks that are located in mixed deciduous and long leafed pine forests. While most collecting localities occur in National Forests, adequate habitats do exist on adjacent private lands. In 1974, Stewart *et. al.* erroneously recorded *A. delosa* from East Texas. Szczytko and Stewart (1977), in their study of the Texas stonefly fauna, listed *A. texana* as *A. nigritta*, and as the only *Amphinemura* species to occur in Texas. The ten counties listed for paratypes above include all those mentioned in Szczytko and Stewart (1977), since all of their specimens were examined as part of this study.

The Louisiana specimens and a series from Texas were supplied by Ed DeWalt of the Illinois Natural History Survey. Riley Nelson of the University of Texas, Austin aided the author in collecting fresh material from several localities in Texas.

ACKNOWLEDGMENTS

The help of the following institutions and individuals, who made their specimens available, is greatly appreciated: Brian Armitage, Ohio Biological Survey; Paul Carlson, Mobile, Alabama; Ed DeWalt, Kathy Methven and Don Webb, Illinois Natural History Survey; Scott Grubbs, University of Pittsburgh; Boris Kondratieff, Colorado State University; Ed Masteller, Pennsylvania State University; Ken Stewart, University of North Texas; Stan Szczytko, University of Wisconsin, Stevens Point; Reese Voshell, Virginia Polytechnic Institute and State University; Bruce Wallace and Cecil Smith, University of Georgia. In addition, I am especially thankful to the following collectors that accompanied me in the field: Shawn Clark, Fred Kirchner, Boris Kondratieff, Riley Nelson, Sam Wells and Mike Whiting. The illustrations were made by Jon Bybee.

LITERATURE CITED

- Claassen, P.W. 1936. New names for stoneflies (Plecoptera). *Ann. Entomol. Soc. Amer.* 24:622-623.
- Hitchcock, S.W. 1974. Guide to the Insects of Connecticut. Part VII. The Plecoptera or stoneflies of Connecticut. *Bull. State Geol. Natur. Hist. Surv. Connecticut.* 107:1-262.
- Provancher, L. 1876. Petite faune entomologique du Canada. *Les Néuroptères. Natur. Canad.* 8:177-191, 209-218.
- Ricker, W.E. 1952. Systematic Studies in Plecoptera. *Indiana Univ. Publ. Sci. Ser.* 18: 1-200.
- Stewart, K.W., R.W. Baumann and B.P. Stark. 1974. The distribution and past dispersal of Southwestern United States Plecoptera. *Trans. Amer. Entomol. Soc.* 99:507-546.
- Szczytko, S.W. and K.W. Stewart. 1977. The stoneflies (Plecoptera) of Texas. *Trans. Amer. Entomol. Soc.* 103:327-378.
- Wu, C.F. 1923. Morphology, anatomy and ethology of *Nemoura*. *Bull. Lloyd Library* 23:1-81.